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NOTES AND DESCRIPTIONS OF NATIVE PSAMMOCHARIDAE

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If one compares the tarsal comb of a *Psammochares* with the front tarsus of a typical *Anoplus* he will see that in the *Psammochares* there is a spine from the middle of the second tarsal joint about as long as that from the tip of the first or tip of second joint, while in the typical *Anoplus* there are spines along the first joint and at the tip of the first and second joints that are fairly long; there is none from the middle of the second joint at all comparable to them. The presence of a spine, of equal length with the others, is then the real character of *Psammochares*. In this sense one can arrange the various forms grouped about *Psammochares* in a more definite way.

The type of *Pompilinus* will go with *Psammochares*, likewise certain species, as *A. tenebrosus*, formerly placed with *Anoplus*.

These and related genera can be tabulated as follows in the female:

1. With a distinct spine near middle of second tarsal joint of front legs as long as that at tip of the joint 4.
No distinct spine except at tip of second joint, and this scarcely longer than width of joint 2.
2. Tip of abdomen with numerous hairs, some plainly stiff and bristly, vertex not raised much above eyes *Anoplus*.
Tip of abdomen with but few very fine hairs 3.
3. Vertex raised considerably above eyes; propodeum nearly vertical and concave behind; base of third submarginal oblique *Anotochares*.
Vertex but little elevated above eyes; propodeum sloping and rounded behind; base of third submarginal cell about vertical or even a little recurved *Anopllochares*.
4. Spines on second joint of front tarsus plainly longer than width of joint, as also those on first and third joints, a true "comb" 7.
Spines on second joint scarcely longer than width of a joint; those on first and third also fairly short 5.
5. Marginal cell hardly its length from tip of wing; third submarginal cell not petiolate; propodeum scarcely hairy *Anoplodes*.
Marginal cell plainly more than its length from tip of wing; third submarginal cell usually petiolate 6.
6. Propodeum hairy above *Anopliella*.
Propodeum not at all hairy *Pompilinus*.
7. Clypeus notched in middle of front margin 8.
Clypeus not notched 9.
8. Propodeum and usually basal antennal joint very hairy; pronotum arcuate behind *Lophopompilus*.
Propodeum and basal antennal joint not hairy; pronotum angulate behind *Notiochares*.
9. Basal segment of abdomen with appressed scales as well as erect hairs; basal antennal joint usually very hairy *Episyron*.
Basal segment of abdomen without the appressed scales 10.
10. Antennae short; the third joint scarcely three times as long as broad; pronotum arcuate behind 11.

Antennae long; the third joint plainly more than three times as long as broad 12.

11. Propodeum hairy *Sophropompilus*.
Propodeum not hairy *Nannopompilus*

12. Femora hairy and abdomen above more hairy than usual *Arachnophila*.
Femora scarcely at all hairy, abdomen hairy above only on base and tip *Psammochares*.

Psammochares henshawi sp. nov.

Body, legs, and antennae wholly black; wings a faded black, veins black, hairy much as in *scelestus*; ocelli about as near eyes as to each other; clypeus faintly concave in middle of front margin; second plus third joint of antennae almost equal to vertex width, basal joint not hairy; pronotum scarcely angulate, but almost evenly arcuate behind; three comb-spines on front basitarsus, not quite as long as in *P. scelestus*; long spur of hind tibia more than half of basitarsus.

In the forewings the second submarginal cell is much like that of *scelestus*, receiving the first recurrent vein near end, but the third submarginal cell, altho as long below, is very much narrowed above, but not to a point, and receives the second recurrent vein (scarcely curved) at or a trifle before the middle; basal vein interstitial with the transverse (usually separated in *scelestus*).

Length of body 13 to 15 mm.

Holotype from Ainsworth, Wash., 20 July 1882 (S. Henshaw), others collected by Mr. Henshaw at Nelson's, 4 to 5 July, Yakima River, 30 June, Yakima City, 2, 3, 4 July, all in Washington, and The Dalles, Oregon, 23 June also from Sonoma Co., Calif., July. Type M. C. Z. no. 23480.

Other paratypes are from Grand Coulee, Columbia River, Wash., 12 July, and Priest Lake, Idaho, August; the latter are in the Washington State College. *P. henshawi* differs from other western species of the genus in that the pronotum is scarcely angulate behind, in others very distinctly so.

Anoplidiodes gen. nov.

Belongs in the group of *Psammochares* in having a spine at middle of second joint of front tarsi; the spines of the comb are short, scarcely more than width of joint. The tip of abdomen has many stout hairs, some bristly. In the fore wings the marginal cell is not more than its length from the wing-tip; the third submarginal cell is not petiolate, but narrowed above. The propodeum has short fine hair.

Anoplidiodes modestus sp. nov.

Body black, wings a little paler, darker near tip, about as in *Anoplodus tenebrosus*. Front with moderately long hair, none on basal joint of antennae, vertex not swollen; ocelli in a low triangle, about equal and of good size, laterals a little nearer to eyes than to each other; faint line from front ocellus to antennae, second plus third joint of antennae much longer than vertex width, which is quite short; clypeus nearly truncate below; pronotum behind scarcely angulate, much as in *A. tenebrosus*; propodeum with very fine, short hair, scarcely noticeable; abdomen with much stiff bristly hair at tip, venter with a few hairs on each segment. Legs moderately long, and spines rather long, front tarsus long with three short spines above, second joint with two short spines, one near middle; long spur of hind tibia scarcely more than one half the basitarsus; the claws are rather longer and the apical part more slender than in *Anoplodus*.

In the fore wings the marginal cell is long, not its length from wing tip; second submarginal rather short, narrowed one half above, receiving the first recurrent vein near end; the third submarginal cell is longer, narrowed only one third above, receiving the second recurrent (bowed outward) at middle; the second discoidal cell is plainly longer than the space beyond it; basal vein interstitial with the transverse; in hind wing the anal ends beyond the cubital fork.

Length 13 mm.

Two females, holotype, Brownsville, Texas, 11 to 16 June, (Darlington); paratype, Dayton, Texas, 20 June (Bequaert). Type M. C. Z. no. 23476.

In size and venation much like *Anoplius depressipes* and *A. similaris*, but both of these lack the spine on second joint of front tarsi; *depressipes* has hairy pleura, and *similaris* a slightly concave clypeal margin, and both a more hairy propodeum.

Anophiella gen. nov.

This is related by the spine at middle of second tarsal joint to *Psamnochares*, but none of the spines are as long as a tarsal joint; the third submarginal cell is triangular, and usually a little pedicellate. The clypeus is not emarginate, the basal joint of antennae not hairy above nor on inner side, the propodeum is plainly hairy. Tip of abdomen with some straight, bristly hairs above.

Genotype, *Pomphilus tenebrosus* Cress.

Anophiella imbecilla sp. nov.

Body, legs, antennae black, wings almost equally fumose, but broadly darker at tip, and nearly hyaline toward base, especially in hind pair. Head, notum, and propodeum with sparse, but moderately long, hair; clypeus margined, in front, nearly truncate; ocelli in low triangle, laterals about as close to each other as to eyes, line from front ocellus to antennae interrupted in middle, second plus third joint of antennae hardly equal vertex-width, vertex about as wide as face at clypeus; pronotum behind plainly angulate; propodeum without distinct median line; basal segment of abdomen almost hairless, tip with a few and the lower ones straight and almost bristly; a few hairs on venter.

Basal joint of front tarsus with three short spines above, second joint with an equally long median spine, all faintly curved; long spur on hind tibia nearly three-fourths of basitarsus.

In fore wings marginal cell short, one and a half times its length from tip, second submarginal narrowed above, receiving the first recurrent a little beyond middle, vein between second and third cells vertical; third submarginal cell about as long as second, much narrowed above, but not petiolate, receiving the second recurrent vein (oblique) near middle; second discoidal cell shorter than space beyond; in hind wings anal vein ends at cubital fork.

Length 8 to 9 mm.

Holotype, M. C. Z. no. 23475, from Colebrook, Conn., 1 to 7 Sept. (Wheeler). Paratype, Baddeck, Nova Scotia, 17 August (Wheeler). Another specimen from Winthrop, Maine, 15 Aug. (Bolster) is the same except the third submarginal cell is shorter.

It differs from *A. tenebrosa* in the pronotum angulate behind, the non-petiolate third submarginal cell, in vein between second and third submarginals being vertical, and in the less bristly hairs at tip of abdomen, much as in *Anoplochares*.

Notiochares angusticeps sp. nov.

Wholly deep black, without iridescence; a few hairs on the vertex and some very short ones on pro and mesonotum, long hair on tip and venter of abdomen and on the coxae. Head extremely slender, face very narrow and narrowed above; ocelli close together, the laterals scarcely a diameter from the front ocellus, laterals closer to each other than to eyes, a line from front ocellus to antennae; the clypeal emargination as large as in *N. philadelphicus*, third joint of antennae much longer than vertex-width; pronotum angulate behind, propodeum strongly arched, in front legs four comb spines on basitarsus, as long as in *philadelphicus*; long spur of hind tibiae not reaching middle of basitarsus; as in other species there are several minute spines arising from pits near the tip of middle femora.

Venation much as in *philadelphicus*, in hind wing the anal ends beyond the cubital fork.

Length of body 16 mm.

A female from Brownsville, Texas, 11 to 16 June (P. J. Darlington). Type M. C. Z. no. 23477.

Easily separated by the very narrow head.

Anotochares gen. nov.

Head large, rounded, vertex rounded, eyes not very large, not nearly reaching top of vertex, ocelli small and far apart; clypeus entire (not emarginate); pronotum long, but not equal to metanotum, somewhat arched. Legs moderately spiny, last joint of hind tarsus with a few median spines, no comb of long spines, front basitarsus with three short spines on outer side, second joint with only the two spines at tip, none in middle. Antennae rather short, but third joint fairly long.

Fore wing with three submarginal cells, the marginal cell scarcely its length from tip. In the hind wing the anal ends much before the cubital fork in an upcurved vein that looks like a crossvein, the main anal vein apparently continued in a short stump.

Anotochares engleharti sp. nov.

Head and thorax blue, metanotum and propodeum black in certain views, abdomen black, with a bluish iridescence over most of the surface; wings evenly violaceous black, veins deep black; palpi and antennae black; legs bluish on femora and tibiae, elsewhere black. Head and thorax above with moderately long hair, long on propodeum, fine hairs on femora and tibiae, pleura hairy, tip and venter of abdomen also.

Head broad, rounded above, clypeus truncate; ocelli very small, in a low triangle, laterals much further from eyes than from each other; pronotum broadly arched; abdomen somewhat flattened, first segment slightly hairy on base and on sides, a few hairs on sides of second segment; basal part of the propodeum flat, then abruptly declivous, a median depression on hind edge of the flat part. Fore wings with marginal cell scarcely more than its length from tip of wing; second submarginal cell nearly quadrate, a little longer than high, receiving the first recurrent vein near tip; third submarginal cell as long below as the second, but much narrowed above, receiving the second recurrent (slightly curved) about at middle; basal vein interstitial with the transverse; in hind wing the anal vein runs nearly parallel to cubitus, then a little before its tip is a curved branch ending before the fork of the cubitus. Long spur of hind tibia hardly two fifths of the basitarsus.

Length of body 17 mm.

One from Fredericksburg, Texas, 10 Oct. (G. Englehart coll.). Type M. C. Z. no. 23481.

Anoplus

The genotype is *Pompilus nigerrimus* Scop. There is no spine at the middle of the second joint of front tarsus, nor are the spines on other joints elongated; the tip of abdomen is provided with some stiff, bristly hairs.

Anoplus wheeleri sp. nov.

Black, body, legs, and antennae. Wings fuscous, but often somewhat paler on basal part. Head short and broad, from upper margin of clypeus to vertex scarcely longer than greatest width of face (face more narrow in *A. virginianensis*); hair on front toward antennae very short; lateral ocelli much closer to each other than to eyes; the line from front ocellus to the antennae faint or absent; second plus third joint of antennae scarcely equal vertex width; pronotum angulate behind; propodeum smooth or hairs so faint as scarcely noticeable, no distinct median groove; little, if any, hair on basal segment of abdomen, that at tip bristly.

Fore wings with the marginal cell shorter than in *A. virginiensis*, outer side straight, third submarginal cell near to a point above; basal vein ends before the transverse; second discoidal cell about as long as the space beyond; in hind wings anal vein ends before cubital fork. Front basitarsus much as in *virginensis*, long spur of hind tibia fully one half of the basitarsus.

The male is much like that of *virginensis*, abdomen perhaps a little shorter, the hair below near tip is still shorter and less dense than in *virginensis*, and the median plate of the genitalia is more pointed at tip.

Length ♂, 7 to 8 mm.; ♀, 8 to 10 mm.

Holotype (♀) from Colebrook, Conn., 6 July '21 (Wheeler); *paratypes* from same locality in July and August, and from Forest Hills, Mass., June. Type M. C. Z. no. 23482.

Differs from *virginensis* in broader face, faint line on face, lack, or almost so, of hair on propodeum, and shorter frontal hair. None of the specimens are as large as the normal *virginensis*.

Anoplochares gen. nov.

Related to *Anoplus* in that there is no comb on the front tarsus of female, no spine at middle of the second joint, and other spines few and short. It differs from that genus in that there are but few hairs at tip of abdomen, all very fine, none bristly, in that there is no hair or almost none on the propodeum, and in that the intermediate vein (the one between the second and third submarginal cells) is erect, not inclined; the third submarginal is not petiolate, the basal vein ends before the transverse; ocelli in a low triangle.

Type, *Pompilinus rectus* Bks.

The two described species are separable as follows:

Front coxae with long hairs half way down; hind wings dark as front wings; size larger	<i>similaris</i>
Front coxae at most with a few short hairs at extreme base, hind wings pale; smaller	<i>rectus</i>

Arachnophroctonus latifrons sp. nov.

In general similar to *A. ferrugineus*; the females, however, wholly pale, sometimes a little dark at base or apex of the propodeum; wings not as dark as in *ferrugineus*; thus in color much like the form of *ferrugineus* which Viereck called *unicolor*. Venation as in *ferrugineus*. It differs from *ferrugineus* (and *unicolor*) in having a proportionally broader vertex and a shorter third joint of antennae, thus the second plus third joint is no longer, usually shorter, than the vertex width. The female also differs from *ferrugineus* in having but three comb-spines on the basitarsus (four or even a short fifth in *ferrugineus*). In the male the thorax is partly dark as in *ferrugineus*, the abdomen, however, shows scarcely a trace of dark at tips of segments. The last ventral segment is similar to *ferrugineus*, with the tip plainly broader, and more rounded, the superior appendages, so plain in *ferrugineus*, are very short, and often do not show at all.

Length of female 12 to 14 mm., male 8 to 10 mm. *Holotype* from Wenass Valley, Taylor's, Wash. Terr., 8 July, 1882 (S. Henshaw), M. C. Z. no. 23474. *Paratypes* from Peachland, B. C., 23 July (Wallis); Greenvie Canon, Utah, 29 August (Titus); Wawawai, Wash., Grand Coulee, Wash., 3 July, 12 July; Los Angeles, Calif. (Hicks); San Diego, Calif. 14 June (Van Duzee); and National City, Calif., 15 May (Van Duzee). Some paratypes are at the Washington State College at Pullman.

Prionemis rufescens sp. nov.

Body, legs, antennae rufous, mesonotum scarcely darker; wings hyaline, no distinct bands, veins pale brown; a silvery pubescence on the posterior slope of the propodeum, less distinct on sternum and pleura; a few erect hairs on

vertex, hair on clypeus, tip and venter of abdomen white, elsewhere scarcely hairy.

Clypeus not extending under the eyes; vertex from in front rounded; ocelli small, in a nearly equilateral triangle, laterals much closer to each other than to eyes, no line from front ocellus to antennae; antennae rather slender, tip brown, second plus third joints about equal two thirds of vertex; mid and hind tibiae with moderately large teeth, long spur of hind tibia about two fifths of basitarsus.

In fore wings marginal cell about its length from tip; second submarginal about one and one half times as long as broad, narrowed above, receiving the first recurrent vein before middle; third submarginal much longer, narrowed about one third above, receiving the second recurrent (bent at middle) before middle; basal vein a little before transverse; in hind wings the anal ends much before cubital fork.

Length 7 mm.

From Aden, New Mexico, 12 July (J. Bequaert). Type M. C. Z. no. 23479.

Prionemis osceola sp. nov.

Head black above antennae, below yellowish as is also the antennae which become brown before middle; palpi brown; thorax wholly black; abdomen mostly black above, but extreme base brownish, and last two segments yellowish; venter partly pale, but segments two and three dark; femora and most of tibiae below yellowish, femora with a brown streak above; tibiae above and the tarsi brown. Wings hyaline, unmarked; veins brown. Head and thorax very hairy, long above and behind on head, most of thorax with rather shorter hairs, but those on scutellum and propodeum very long, also at tip of abdomen.

Beneath the hairs is a fine pubescence, which in some views is golden.

Clypeus nearly three times as broad as long, truncate below, sides rounded, and upper angles extended a little under the eyes; usual group of bristles in the middle.

Pronotum behind slightly angulate. Propodeum rounded, with a deep pit in middle of base, followed by a line for a short distance.

Stigma over three times as long as broad, sides parallel; second submarginal cell twice as long as broad, base oblique, receiving the first recurrent at middle; third submarginal much longer and broader at tip than the second, tip oblique, reaching a little beyond marginal cell, receiving the slightly curved second recurrent much before middle. In hind wing the anal cell ends plainly before the fork.

The hind tibia has about ten teeth in the row, each followed by a short bristle; the long spur of hind tibia is about one half of the basitarsus.

Length of body 7 mm., of fore wing 6.5 mm.

Two females, one from Orlando, 8 April (Paige coll.), other from South Miami, 5 June (Graenicher coll.), both Florida. Type M. C. Z. no. 22119.

In size and color much like *Pseudagenia floridana*, and structurally also except for the hind tibiae and other generic characters.

Dipogon graenicheri sp. nov.

Head pale rufous, thorax, legs, and antennae yellowish, abdomen brown, wings hyaline, two yellowish brown bands, one over basal vein, other broader at stigma, and also across wing, and rather broader than in *D. caliptera*, stigma yellow. In structure and pilosity it is closely similar to *D. caliptera*, but hair on abdomen is paler; the propodeum is smooth and polished, the median line very faint. The long spur of hind tibia is scarcely more than one third of the basitarsus. In the fore wing the second submarginal cell is three times as long as broad, and about twice as long as the third submarginal cell. The second cell

receives the first recurrent vein much before the middle, the third cell is short, and receives the second recurrent near base as in *caliptera*, but the outer side is plainly curved.

Length 5.5 to 6.5 mm.

Two specimens from South Miami, Florida, 20 March, 16 May (Graenicher coll.). Type M. C. Z. no. 23478. Readily separated from all our other species by the pale head and thorax.

EXPLORATIONS OF THE HYPOPHARYNX IN NOCTUID LARVAE

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While making a study of the larvae of certain species of Noctuidae, the writer was impressed by differences observed in the structure of the hypopharynx. A survey of the literature reveals that, though some workers have paid a certain amount of attention to this organ in larval Lepidoptera, the literature on the subject is not extensive. Trägårdh (5) made a morphological study of this part of the mouth in leaf-miners. de Gryse (3) wrote a brief paper on the subject embracing a number of widely separated families in the Lepidoptera. He examined material scattered over some twenty widely divergent families describing six species representative of the most remarkable cases met in the course of his research. The species illustrated and described are *Papaipema nitela* Gn., *Lagoa crispata* Pack. *Coleophoora vernoniaeella* Chambers *Gracilaria* sp., *Acrocercops strigisinitella* Clemens, *Ectoedemia heinrichi* Busck and a sesiid larva. Ripley (4) who made an extensive study of the external morphology and postembryology of noctuid larvae, in describing the hypopharynx states that it bears numerous small setae, whose distribution, form, size and number vary greatly within the family, offering excellent generic and specific characters. Crumb (1), admitting that the hypopharynx presents a multiplicity of characters, states that it is disappointing when closely related species are to be differentiated owing to the fact that great uniformity prevails with regard to the structure in these species, and the slight specific tendencies are rendered of dubious value by the rather wide variations which occur among individuals. He points out, however, characters in the spinneret which may be of taxonomic value. Illustrations of the spinneret of twenty-three species of tobacco cut-worms are given by this author. In these drawings he shows how they fall into four classes, explaining in his text that the spinneret is very variable in form in many cases, but these variations do not exceed the bounds of a class to which a particular form belongs. Like the hypopharynx, Crumb states, the spinneret preserves a strong generic homogeneity and for this reason is of little service in distinguishing closely related species of larvae.

From this brief resumé of some of the literature on the subject it appears that the hypopharynx will at least present generic characters of value in differentiating noctuid larvae, and perhaps in many cases may be useful in differentiating species.

With this in mind a few preserved specimens whose identity was known were examined and drawings of the hypopharynx made. For the greater part, these species are in widely separated genera, though two *Papaipema* and one species of *Hydroecia* were drawn which show their resemblance, presenting perhaps a generic type. Differences in structure and arrangement of setae in these closely allied species are not difficult to distinguish.

Crumb's terminology for the parts of the hypopharynx has been adopted in this paper. By him this structure is described as follows: "The hypopharynx is an oval fleshy part extending upward and backward in the floor of the mouth and merging into the labium anteriorly. It is broadest posteriorly and may be divided into three parts: (1) A raised anterior portion, the lingua, which merges posteriorly into (2) a pair of lateral lobes, the lobes of the maxillulae,

and (3) a depressed area between these lobes which may be called the "gorge". The armature of spines is usually particularly heavy in an area at or near the anterior ends of the maxillulae, the premaxillary area. The lobes of the maxillulae are usually bordered on their extero-lateral margins by a row of spine-like processes, borne on a chitinous plate, the blade of the maxillulae, which shields the maxillulae laterally and is attached to the arm of the mentum. The lingua and maxillulae are armed with spines, while the gorge is usually nearly or quite bare".

The drawings of the species illustrated in this paper are sufficient in themselves to show how greatly this structure is modified in the noctuid family. The spinneret, and labial palpi, because of their variation and probable taxonomic value, have been included in these illustrations.

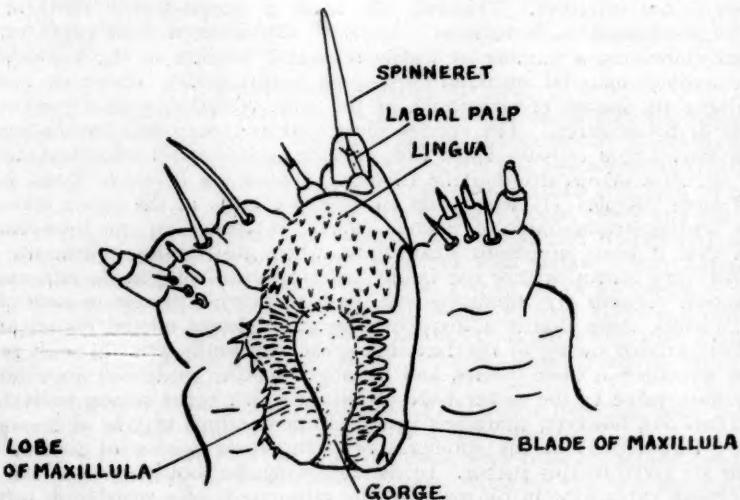
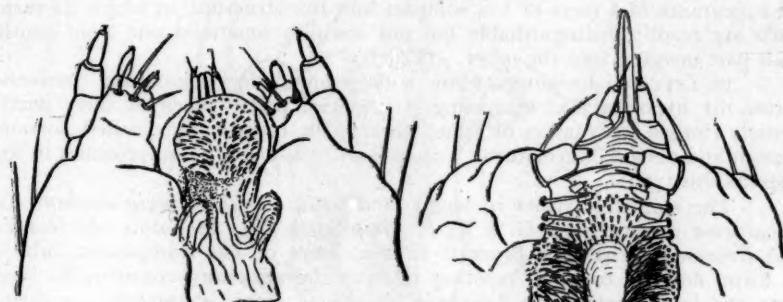
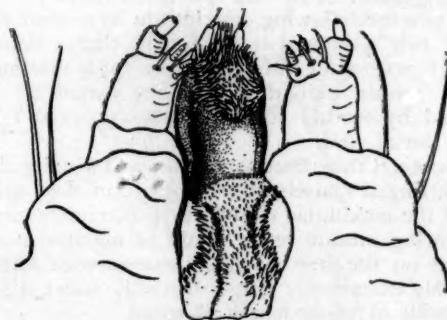
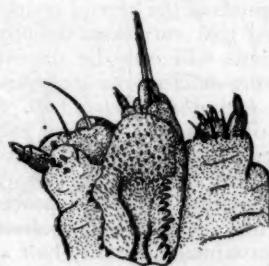


DIAGRAM OF HYPOPHARYNX

Obvious modifications are found in the various parts of the hypopharynx and in the spinneret. The lingua is sometimes densely clothed with hairs or lashes or sometimes with erect spines. In *Papaipema purpurifascia* G. & R., *Hydroecia immanis* Gn. and *Crymodes devastator* Brace it is bare. The gorge varies in length and width as can be seen by comparing this part in the species illustrated. It is usually bare of setae though in *Leucania unipuncta* Haw., setae are borne on three parts of its length distally. The margins of the blades of the maxillulae are free with spine-like processes in *Heliothis obsoleta* Fab., *Peridroma margaritosa* Haw., and *Agrotis orthogonia* Morr. These spine-like processes vary in form and number and seem to present an excellent character for differentiation. Their number, however, varies slightly within individuals of the same species. In *Catocala antinympha* Hbn., *Crymodes devastator* Brace, *Hydroecia immanis* Gn., *Papaipema purpurifascia* G. & R. and *P. cataphracta* Grt., the blades of the maxillulae are without spine-like processes. In *Catocala antinympha* Hbn. the lobes of the maxillulae appear as arm-like structures with some eight spine-like processes on their distal margins. These spine-like processes

PLATE 25

*Calosola antonympha* Haw.*Crymodes deuastator* Brues*Leucania uniformis* Haw.*Heliothis obsoleta* Fab.*Peridroma margaritosa* Haw.

THE HYPOPHARYNX IN NOCTUID LARVAE

are directed medially. The whole structure appears like an organ that would assist in passing the food back into the mouth.

In general form the hypopharynx varies greatly. Usually it presents an appearance of a more or less compact lobe-like structure, in which its various parts are readily distinguishable but not distinctly separated one from another, each part merging into the other. (Fig. 1.)

In *Leucania unipuncta* Haw. a deep broad depression runs transversely across the hypopharynx, separating it into two parts. Each of these parts is densely clothed with lashes or setae, whereas the transverse depressed portion is smooth and devoid of armature. *Catocala antinympha* Hbn. approaches in some respects this type.

The spinneret varies in length and form. In *Hydroecia immanis* Gn., *Papaipema purpurifascia* G. & P., *P. cataphracta* Grt., *Heliothis obsoleta* Fab. and *Crymodes devastator* Brace it is thin, more or less transparent, tube-like in form, dorsally concave, tapering towards the apex and considerably longer than the labial palps. In *Leucania unipuncta* Haw., *Peridroma margaritosa* Haw., *Agrotis orthogonia* Morr., and *Catocala antinympha* Hbn., it is about as broad as long and a great deal shorter than the labial palps. In *A. orthogonia* Morr. and *C. antinympha* Hbn. it is bluntly rounded distally whilst in *L. unipuncta* Haw. and *P. margaritosa* Haw. it is fimbriated regularly in the former and irregularly in the latter.

DESCRIPTION OF THE HYPOPHARYNX IN THE SPECIES STUDIED

Though in practically all cases the following descriptions have been made from the examination of one or two specimens it is thought that a detailed description of the hypopharynx as it was found will be of value. It is thoroughly realized that variations do occur within individuals, but the extent of these variations will only be discovered by further study of more material. The following descriptions are from a dorsal view.

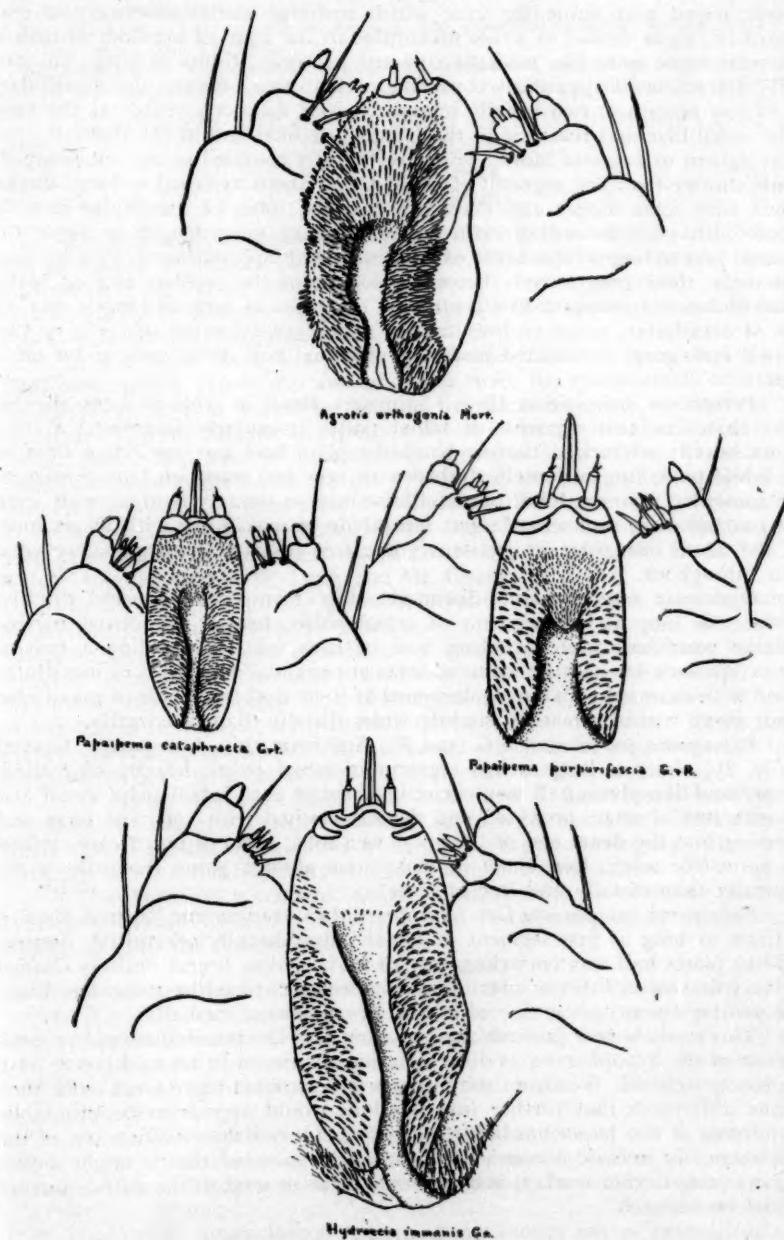
Heliothis obsoleta Fab. Spinneret thin, transparent, tapered distally about three times as long as labial palps; lingua sparsely armed with short erect spines, heavier posterio-laterally; lobes of the maxillulae clothed with extremely minute setae; distal end of gorge also bearing minute setae; blade of maxillulae with flat triangular tooth-like processes on the free margin, these vary in number from nine to twelve (6 individuals examined); gorge distinctly wider distally than proximally, distally half as wide as whole length of gorge.

Leucania unipuncta Haw. Spinneret about as long as first two segments of labial palps, two-thirds as wide as long, tip regularly fimbriated; hypopharynx divided medially by a smooth transverse depressed area devoid of setae; distal area of hypopharynx or lingua densely clothed with stout setae which converge from the sides medioposteriorly, those at distal end standing erect; lobes of maxillulae densely clothed with setae, which are not as long as on the lingua; gorge bearing setae for two-thirds of its length, proximal third devoid of setae, distal end of gorge twice as wide as proximal end; blade of maxillulae with about fifteen flat, acute triangular tooth-like processes.

Crymodes devastator Brace. Spinneret thin, transparent, tapered distally, three times as long as first segment of labial palps; distinct narrow plate encircling base of labial palps; lingua distally free of armature, bearing fine transverse striae, proximally sparsely armed with short stout spines in irregular rows; lobes of maxillulae densely clothed with medially converging overlapping setae, their lateral margins with short spines, proximal third of lobes free of armature except on their lateral margins which bear setae intermingled with spines; gorge entirely free of armature of about same width throughout, slightly constricted medially, four times as long as wide; free blade of maxillulae absent.

Catocala antinympha Hbn. Spinneret transparent, bluntly rounded at tip, shorter than first two segments of labial palps, two thirds as broad as long;

PLATE 26



THE HYPOPHARYNX IN NOCTUID LARVAE

lingua separated from remainder of hypopharynx by a transverse depressed area, sparsely armed with spine-like setae which converge medio-posteriorly, lateral margins of lingua devoid of setae; maxillulae in the form of arm-like structures with some eight spine-like medially directed processes; limits of gorge not distinctly differentiated apparently consisting of that area between the maxillulae, free of any armature; two heavily sclerotized rods distinctly visible at the base of the maxillulae and reaching to the lateral proximal end of the lingua.

Agrotis orthogonia Morr. Spinneret bluntly rounded at tip, cone-shaped, slightly shorter than first segment of labial palps, about as broad as long; lingua clothed with setae longer and denser proximally; lobes of maxillulae densely clothed with posterio-medially converging setae of same length as those on proximal part of lingua; free blade of mixillulae with approximately 27 spine-like projections, these progressively becoming longer in the median area of blade of maxillulae, longest spine-like projection $1\frac{1}{2}$ times as long as longest seta on lobes of maxillulae; gorge entirely free of setae except for the odd one or two at distal end, gorge constricted medially, proximal and distal ends about same width.

Peridroma margaritosa Haw. Spinneret about as wide as long, slightly longer than first two segments of labial palps, irregularly fimbriated at tip; distinct heavily sclerotized narrow band-like plate half way encircling base of each labial palp; lingua densely clothed with very fine setae, on lateral margins setae somewhat coarser; lobes of maxillulae not so densely clothed with setae as lingua but setae somewhat larger; free blade of maxillulae with about fourteen flat acute triangular projections; gorge free of setae, approximately same width throughout.

Hydroecia immanis Gn. Spinneret thin, transparent, tapered distally, $2\frac{1}{2}$ times as long as first segment of labial palps; heavily sclerotized narrow band-like plate half way encircling base of each labial palp; lingua free of setae except for a few minute scattered setae at proximal end; lobes of maxillulae clothed with short spine-like setae darkened at their tips; free blade of maxillulae absent; gorge free of armature, slightly wider distally than proximally.

Papaipema purpurifascia G. and R. Spinneret thin, transparent, tapered distally, $2\frac{1}{2}$ times as long as first segment of labial palps; heavily sclerotized narrow band-like plates half way encircling base of each labial palp; distal end of lingua free of setae, proximal end densely clothed with very fine setae and projecting into the distal end of the gorge as a lobe; lobes of maxillulae clothed with spine-like setae; free blade of maxillulae absent; gorge distinctly wider proximally than distally and free of setae.

Papaipema cataphracta Grt. Spinneret thin, transparent, tapered distally, $2\frac{1}{2}$ times as long as first segment of labial palps; heavily sclerotized, narrow, band-like plates half way encircling base of labial palps, lingua entirely clothed with very fine setae; lobes of maxillulae with coarser spine-like setae; free blade of maxillulae absent; gorge free of armature, constricted medially.

This study is very preliminary in nature and the possibilities of the modifications of the hypopharynx as differentiating characters in noctuid larvae have been barely touched. Yet from the few species examined there seem to be such extreme differences that further investigations would appear to be profitable. The purpose of this paper has been to merely point out the modifications of the hypopharynx in noctuid larvae with the thought in mind that it might arouse interest amongst other workers and persuade them to send to the author further material for research.

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A REVIEW OF THE GENUS SERROPALPUS, (COLEOPTERA,
MELANDRYIDAE)

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The genus *Serropalpus* differs from other genera in the tribe Serropalpini in having an almost obliterated suture between the prosternum and the episternum, long slender antennae, and strongly serrate maxillary palpi which have a cultriform terminal segment. It is like *Phloeotrya* and *Dircea* in having a short prosternum before the anterior coxal cavity.

In the Leng check list, under the species *barbatus*, are listed the two Haldeman species, *substriatus* and *obsoletus*, with the questionable addition of the European *striatus* which by Seidlitz has been regarded as identical with *barbatus*. The two Haldeman types are in the Leconte collection at Cambridge, Massachusetts, and have been examined. Six specimens of the European *barbatus* have been available due to the kindness of Dr. K. G. Blair of the British Museum, as well as two from Europe included in the Charles W. Leng collection. American specimens of the genus, besides those in the Leconte collection, have been examined from the collections of Dr. Henry Dietrich, Dr. H. C. Fall, Mr. Ralph Hopping, Mr. C. W. Leng, and Mr. Charles Schaeffer.

In the treatment of the genus by Seidlitz, three species were regarded as distinct in America, namely, *barbatus*, *substriatus*, and *obsoletus*. The material which he used as examples of *substriatus* (Mus. Heyden) could not have been correctly identified. *Substriatus* is definitely stated by him, for example, to have the middle coxae separated by a prolongation of the mesosternum. The type of *substriatus* in the Leconte collection does not have this trait. There is, however, an American species hitherto unnamed which must have been the species supposed to have been an example of Haldeman's *substriatus*.

As far as specimens have been examined, I have found no American specimens of the genus which seem to agree with *barbatus*. Therefore it is likely that it should be removed from the American catalogues. However, in the table below it has been included for the sake of comparison.

The American specimens include, then, *substriatus*, *obsoletus*, and a new species, *Serropalpus coxalis*. The table and descriptions below will serve, it is hoped, to show the distinctions.

KEY TO THE GENUS SERROPALPUS.

- A. Middle coxae separated; no deep distinct medial pit at the base of the thorax.
- B. Tip of each elytron sharp, sometimes even with a projecting point; hind angle of the thorax sharply angulate with a tendency to very slightly point back toward the humeri..... *barbatus* Schall.
- BB. Tip of each elytron not sharp; hind angle of the thorax somewhat depressed.
 - C. Sharp lateral margin of the thorax curved out at middle of the thorax; elytra with scabrous punctate surface not extending to the apex; punctures so spaced that the surface is shiny in appearance..... *substriatus* Hald.
 - CC. Sharp lateral margin of the thorax not as perceptibly curved out at the middle of the thorax; elytra with the scabrous punctate surface extending to the apex; punctures closer together making the surface dull..... *obsoletus* Hald.

AA. Middle coxae contiguous; hind angle of the thorax somewhat obtuse, lateral edge of the thorax gradually rounded out from the hind angle, thorax with a distinct medial pit at the base, flanked with depressions on either side *coxalis* n. sp.

Serropalpus barbatus Schall.

Vertex of head visible from above; eyes large, flat, slightly emarginate, reaching forward to the cavity where the maxillary palpi are inserted; clypeus more than half as long as the labrum and smooth; labrum narrow, exposing the mandibles both at the front and on the sides. Antennae much longer than the head and thorax combined, 2nd segment alone short. Maxillary palpi large, serrate, 1st segment small, 2nd triangular, 3rd with a much extended projection, 4th cultriform fitting against the extended projection of the 3rd segment. Labial palpi small.

Thorax visibly broader than long, margined at base with only a faint indication of a depression at the middle and on either side of the middle. Hind angle practically a right angle but that part of the thorax having a tendency to point back toward the humeri. Lateral edge of the thorax margined from the base about $\frac{3}{4}$ of the distance to the front. Margin straight anterior to the hind angle but somewhat rounded out at the middle. No anterior angles.

Elytra finely punctured, each with nine ridges. Striae sometimes with and sometimes without punctures. Each elytron sharply pointed at the apex sometimes even with a projecting point. Elytra not flat but rounded to hug the body. On the humeri, ridges interrupted by rough transverse lines. Surface brown, pubescence yellowish.

On the under surface prosternum narrow; no suture between the prosternum and episternum; anterior coxal cavities with a lateral fissure. Middle coxae separated by a projection of the mesosternum. Abdominal segments five in number with a sixth sometimes visible in the male. Segments margined laterally.

Seidlitz believed *barbatus* was identical with *striatus*.

Locality—Europe and Siberia.

Length—6–18 mm.

Serropalpus substriatus Hald.

Described from the northeast boundary of Maine.

Head finely punctured, but punctures slightly deeper and spaced farther apart than in *obsoletus*. Brown with fine yellowish pubescence. Front convex, Eyes large, coarsely faceted, slightly emarginate. Antennae much longer than the head and thorax combined, slender. Maxillary palpi large, strongly serrate, terminal segment cultriform.

Surface of the thorax more shiny than in *obsoletus*. Punctures not as close together and rather deeper than in *obsoletus*. Thorax margined posteriorly and laterally usually rather more than $\frac{3}{4}$ of the way to the anterior margin. The extent of this sharp margin is somewhat variable. Posterior margin wavy, more narrowly margined near the posterior angles. Lateral margin faintly sinuate before the posterior angle, curved out at middle of the thorax. From the disc toward the lateral edge, at first convex, then with slightly expanded area toward the edge. Posterior angle obtuse with depressed area anterior to it. The posterior angle shows no sign of pointing back toward the humeri as in *barbatus*. Slight depression at middle of the posterior margin of the thorax with faint indications of depressions on either side at the base.

granulata Elytra not singly pointed at the apex as in *barbatus*; surface scabrous *punctate* but this area does not extend to the apex; indistinct striae usually without any sign of punctures. Whole surface shiny due to a punctuation that is less compact than in *obsoletus*. From some angles the punctuation particularly in the basal half appears to be arranged in transverse lines.

granulata

On under surface, no suture between the prosternum and the episternum; prosternum short in front of the anterior coxae; anterior coxal cavity with lateral fissure. Middle coxae separated by prolongation of the mesosternum.

Male with sixth abdominal segment visible.

Specimens have been examined from N. J.; N. Y.; Brookline, Mass.; Mt. Washington, N. H.; Southport, Me.; Trinity Valley, B. C.; Pender Harbor, B. C.; Loren, B. C.; Aspen Grove, B. C.; Giant Forest, Cal.; Kibbing, Minn.; Mt. Katahdin, Me.; Chippewa Co., Whitefish Pt., Mich.

Length—9–18 mm. Width—2–2.5 mm.

Serropalpus obsoletus Hald.

Described as from Lake Superior and Oregon.

Differs from *substriatus* in being darker in color; in having the surface of the elytra dull due to the closer, rougher punctation; with the lateral margin of the thorax less curved outward at middle of the thorax. The lateral margin, often at least, extends much more than $\frac{3}{4}$ of the distance to the anterior margin. The depression before the posterior angles in the type is slight, without evident expanded area along the lateral margin. Base margined but without the deep medial pit found in *Serropalpus coxalis*.

Elytra scabrous punctate, with punctures closer together than in *substriatus* and extending clear to the apex although the basal half is rougher. Striae less distinct than in *substriatus*, not punctate. Abdominal segments margined. Tip of elytra not sharp like *barbatus*.

On under surface like *substriatus* with middle coxae separated by the mesosternum.

Male with the sixth abdominal segment visible and a larger terminal segment on the maxillary palpi.

Specimens examined include those in the Leconte collection which have no place labels except for one from Vancouver, and specimens from Trinity Valley B. C.

Length—10–12 mm. Width—2–2.5 mm.

Two specimens, one from Chippewa Co., Whitefish Pt., Mich. and one from Minn. agree with the typical *obsoletus* in such traits as punctuation, color, dullness of surface, but differ in that the thorax has before the posterior angle deeper depressions than in either *obsoletus* or *substriatus*. The name *Serropalpus obsoletus perforatus* n. var. is suggested to indicate this variety. These two specimens are in the collection of Dr. H. C. Fall.

Serropalpus coxalis n. sp.

Not as sericeous as *substriatus*. Front not convex but with broad depression.

Thorax marginated at the base and on the sides about $\frac{3}{4}$ of the distance to the anterior margin. Deep medial pit at the base of the thorax flanked by less deep depressions on either side. Sharp lateral margin curved out from the hind angle, without any sinuation before the hind angle. Widest part of the thorax back of the middle. Posterior angle obtuse.

Elytra scabrous punctate with the striae distinct and punctured. Elytra not sharply pointed at the tip, more rounded than in any other species.

On under surface like *substriatus* except that the middle coxae are contiguous.

Specimens were examined from Dummerston, Vt. (type); Southport, Me.; Brookline, Mass.; Mt. Washington, N. H.; N. Y.; Highlands, N. J.; Little River, N'Fl'd.; Duluth, Mich.; Ft. Yukon, Alaska; Minn.; Chippewa Co., Whitefish Pt., Mich.

Length—6–13– mm. Width—1.5–3 mm.

THE USE OF A BAMBOO POLE DRAG IN ENHANCING THE VALUE OF DUSTS IN THE CONTROL OF THE PEA APHID

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The pea aphid infestation at Howick, Aubrey and Brysonville, Quebec, was severe in 1938. On June 28, complete commercial dusting equipment and a sufficient amount of rotenone-bearing dust were brought to the fields for the treatment of peas against the insect.

In the course of dusting operations, the writer who was present as an interested observer, noted that an important proportion of aphids were not disturbed by the dusting and remained alive even a full week after field treatment. This particular condition, especially in short stem peas, resulted in a lower aphid mortality than could reasonably be expected from the performance of the dust under other conditions, and the danger of a continuation of the infestation was feared.

Following a careful study of what actually happened in several pea fields after a thorough application of the dust, some observations were made which led to a very interesting experiment. This experiment consisted in using a



Control of the Pea Aphid

light drag which was attached to the 33 foot distribution boom of the power duster. The drag was made of ordinary bamboo fishing poles cut to proper lengths to match each of the three sections of the duster boom, making therefore three separate drags; two long ones, (13 feet each), and a short one, (6 feet). Each drag was composed of three bamboo lengths attached together by three small ropes so as to leave a space of about one foot between each pole as illustrated in Fig. 1. The drag extended approximately four feet over all behind the duster boom and occupied the space directly behind the boom under the light canvas apron used during the dusting.

The effect produced by the use of such a drag attachment was so striking that the experiment was repeated in several large pea fields in the localities above mentioned.

Immediately after the duster, equipped with the drag, had applied the rotenone bearing dust on heavily infested peas, the treated plants were completely freed from aphids and the ground beneath was covered with partly paralyzed insects. The bamboo drag produced a swift brushing effect on the infested peas and dislodged nearly all the aphids feeding on terminal growths. While the insects were being so dislodged, the whirl of dust produced from the power duster boom came in contact with the aphids which did not survive the effects

of the dust. Subsequent inspections of treated pea fields showed that a complete aphid control was obtained without the least injury to the plants.

It is well known that a considerable proportion of the aphids feeding on the terminal growths of pea plants is inaccessible and consequently protected against a dust. Taking advantage of the natural habit of the pea aphid to drop off the plant when disturbed, a simple device, such as the one described above, dislodges the insects from their protected quarters and exposes them fully to the effects of the material.

THREE INTERMOUNTAIN APHIDS*.

CLYDE F. SMITH AND G. F. KNOWLTON,

Columbus, Ohio, and Logan, Utah

The following report deals with three apparently undescribed species of *Macrosiphina* ** collected upon *Lonicera* and *Geranium* in the Logan Canyon-Beaver Creek areas of northern Utah and just over the state line into Idaho.

Amphorophora crystleae n. sp.

Apterous vivipara: Color pale whitish green; body 3.9 to 4.2 mm. long; antennae 6.3 to 6.9; antennal III, 1.24 to 1.36 mm. long and bearing 22 to 40 sensoria; IV, 1.16 to 1.34; V, 1.15 to 1.29; VI, 0.27 to 0.34 plus 2.1 to 2.31; rostrum attaining second coxae; rostral IV plus V, 0.16 to 0.19; hind tibiae 3.12 to 3.82; hind tarsi 0.18 to 0.22; cornicles 1.48 to 1.58 mm. long, the distal 0.14 to 0.17 mm. being reticulated; cauda 0.6 to 0.73 mm. and bearing 5 to 6 pairs of lateral hairs and 2 or 3 dorsal ones.

Collections: On the undersides of leaves of twin-berry, *Lonicera involucrata*, along Beaver Creek in Idaho and Utah, July 25 and August 22, 1937 (Crystle K. Smith).

The writers have named this species in honor of Mrs. C. K. Smith, wife of the senior writer, and recognize the aid she has given on many occasions in collecting aphids and their parasites.

Alate male: Body 2.3 to 3.2 mm. long; antennae 6.12 to 6.24; antennal hairs 0.027; antennal III, 1.16 and bearing approximately 70 sensoria; IV, 1.13 mm. and bearing approximately 40 sensoria; V, 1.14 having approximately 33 sensoria; VI, 0.3 plus 2.16; rostral IV plus V, 0.15; hind tibiae 3.02; hind tarsi 0.17; cornicles 0.91 long, the distal 0.12 mm. of which is reticulated; cauda 0.3 mm. long and bearing 5 to 6 pairs of lateral hairs.

Collections: On leaves of *Lonicera involucrata* along Beaver Creek in Idaho, August 22, 1937 (Crystle K. Smith).

Taxonomy: This species keys closest to *Amphorophora rubicola* (Oest.) in Mason's key (Proc. U. S. Nat. Mus. 67:6. 1925) from which it differs in having more sensoria or antennal III and antennals III, IV and V conspicuously longer.

Macroscaphus aetheocornum n. sp.

Apterous vivipara: Color greenish; body 3.3 to 3.5 mm. long; hairs on vertex 0.04 to 0.05; hairs on antennal III, 0.041 to 0.046; antennae 3.8 to 3.98; antennal III, 0.97 to 1.02 mm. long and bearing 6 to 9 sensoria; IV, 0.69 to 0.75; V, 0.64 to 0.69; VI, 0.157 plus 0.92 to 1.05; rostrum attaining third coxae; rostral IV plus V, 0.17 to 0.19; hind tibiae 2.5 to 2.8; hind tarsi 0.14 to 0.15; cornicles 1.09 to 1.22 mm. long, the distal 0.16 to 0.2 being reticulated; cauda 0.5 to 0.53 mm. long and bearing 3 to 4 pairs of lateral and 2 or 3 dorsal hairs.

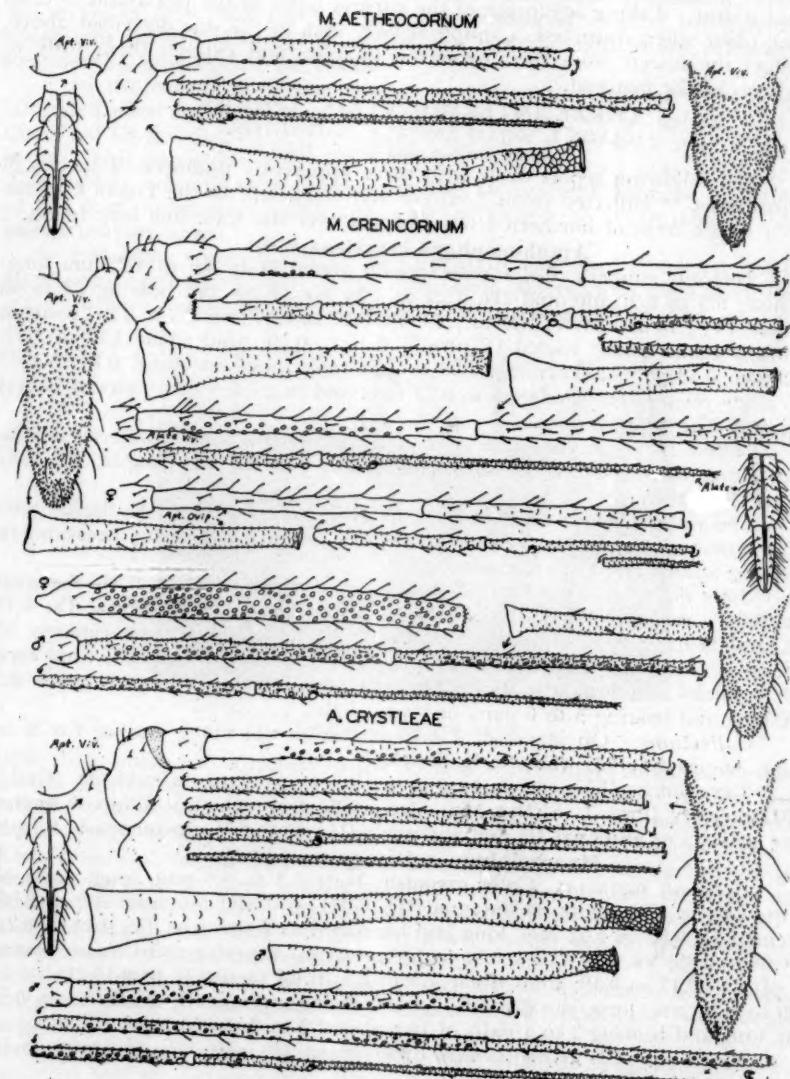
Taxonomy: *M. aetheocornum* differs from *M. solanifolii* in having hairs on the cornicles.

Collections: On wild geranium, *Geranium* sp., along Beaver Creek in Logan Canyon, Utah, August 1, 1937 (Crystle K. Smith, C. F. Smith); Logan Canyon, July 18, 1939 (G. F. Knowlton).

* Contribution from the Departments of Entomology, Utah Agricultural Experiment Station and Ohio State University.

** The writers are indebted to Professor M. A. Palmer and Dr. P. W. Mason for their opinions concerning the species herein recorded.

PLATE 27



INTERMOUNTAIN APHIDS

***Macrosiphum crenicornum* n. sp.**

Apterous vivipara: Color light green with a dark, faint longitudinal stripe on the dorsum; body 3.45 to 5.07 mm. long; hairs on vertex 0.05 to 0.06 mm.; hairs on antennal III, 0.034 to 0.047; antennae 3.42 to 3.81; antennal III, 0.86 to 0.91 mm. long and bearing 6 to 14 sensoria; IV, 0.74 to 0.9; V, 0.48 to 0.58; VI, 0.14 to 0.17 plus 0.83 to 0.97; rostrum attaining third coxae; rostral IV plus V, 0.19 to 0.21 mm. long; hind tibiae 2.33 to 2.77; hind tarsi 0.11 to 0.125; cornicles 0.86 to 1.02; cauda 0.48 to 0.52 mm. long and bearing 7 to 10 pairs of lateral hairs and 2 or 3 dorsal ones.

Alate vivipara: Color light green with a dark, faint, longitudinal stripe on the dorsum; body 2.82 to 4.92 mm. long; hairs on vertex 0.034 to 0.04; hairs on antennal III, 0.34 to 0.4; antennae 3.17 to 4; antennal III, 0.86 to 0.92 mm. long and bearing 17 to 28 sensoria; IV, 0.84 to 0.91; V, 0.62 to 0.67; VI, 0.15 to 0.17 plus 0.97 to 1.06; rostrum attaining third coxae; rostral IV plus V, 0.18 to 0.21 mm. long; hind tibiae 2.38 to 2.5; hind tarsi 0.12 to 0.14; cornicles 0.69 to 0.81; cauda 0.37 to 0.45 mm. long and bearing 4 to 5 pairs of lateral hairs and 2-4 dorsal ones.

Apterous ovipara: Color greenish; body 2.8 to 3.05 mm. long; hairs on vertex 0.04 to 0.045; hairs on antennal III, 0.038 to 0.04; antennae 2.75 to 2.92; antennal III, 0.67 to 0.72 mm. long and bearing 3 to 5 sensoria; IV, 0.59 to 0.62; V, 0.41 to 0.48; VI, 0.11 to 0.13 plus 0.62 to 0.7; rostral IV plus V, 0.17 to 0.18; hind tibiae 2.11; hind tarsi 0.12 to 0.14; cornicles 0.65 to 0.76; cauda 0.34 to 0.39 mm. long and bearing 4 to 5 pairs of lateral hairs and 2 or 3 dorsal ones.

Alate male: Color greenish; body 2.19 to 2.35 mm. long; hairs on vertex and antennal III, 0.034; antennae 3.07 to 3.37; antennal III, 0.76 to 0.86 mm. long and bearing 48 to 57 sensoria; IV, 0.73 to 0.8 and bearing 18 to 23 sensoria; V, 0.53 to 0.57 long with 13 to 16 sensoria; VI, 0.12 to 0.14 plus 0.78 to 0.86 mm. long and bearing 0 to 2 secondary sensoria on the basal portion; rostral IV plus V, 0.18 to 0.19 mm.; hind tibiae 2.16 to 2.2; hind tarsi 0.11; cornicles 0.53 to 0.56; cauda 0.23 to 0.25 mm. long and bearing 4 to 5 pairs of lateral hairs and 2 to 4 dorsal ones.

Taxonomy: *M. crenicornum* differs from *M. aetheocornum* in lacking the closed reticulations on the tip of the cornicles.

Collections: All forms were collected on wild geranium, *Geranium* sp., along Beaver Creek in Utah and Idaho during the month of August, 1937. (Crystle K. Smith, C. F. Smith, F. C. Harmston); abundant at Tony Grove and Amazon Mine areas of Logan Canyon and at Monte Cristo, in Utah, July 18, 1939 (G. F. Knowlton).

Types: Type material will be deposited in the United States National Museum and in the collections of the writers.

TIME OF CUT AS A FACTOR INFLUENCING INFESTATION OF CONIFEROUS LOGS

BY P. M. MORLEY,

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During the summer months, dead and weakened trees and logs left in the woods are subject to attack by a variety of insects, mainly of the order Coleoptera. Some are wood-boring forms which cause a depreciation in the potential value of the lumber; others are barkbeetles which at times may build up in numbers sufficient to cause a primary attack on the living stand.

Although a certain amount of previous investigation has yielded in-

formation on the general biology of many of these insects, there is a distinct lack of more precise knowledge as to the relation which individual life histories have to each other and as to the total effect of their combined action on the habitat, the log. The present paper deals with the time of cut, in its relation to the infestation of pine, spruce and balsam logs in Eastern Canada.

All work on this problem was carried out at the Forest Insect Laboratory at Laniel, Que., during the summers of 1937 and 1938 and was corroborated in part by observations made on sample plots in the Petawawa Forest Reserve in 1937. All the original work was quantitative in nature and consisted of an analysis of the insect populations in logs taken from trees cut at bi-weekly intervals throughout the year. Species represented were white, red and jack pine, black and white spruce, and balsam fir. Cuttings were distributed over five different sites. Each of these sites was subdivided into two or more subsites or stations intended to compensate for varying light conditions within the site. Logs were placed upon low racks just off the ground. Hardwood stringers were used and much the same technique as that proposed by Martin (1936) was followed, each log being individually exposed, not arranged in piles. This analysis has permitted a qualitative grouping under certain time periods of cutting.

Insects infesting the logs have been divided for convenience into six groups, according to their feeding habits. These are:

Group I.

Barkbeetles—Scolytidae.
Ips pini Say.
Polygraphus rufipennis Kby.
Dryocoetes affaber Mann.
Pityogenes hopkinsi Sw.
Pityokteines sparsus Lec.
Orthotomicus caelatus Eich.

Group II.

Ambrosia beetles—Scolytidae.
Trypodendron bivittatum Kby.
Gnathotrichus materiarius Fitch.

Group III.

Bark weevils—Curculionidae.
Pissodes approximatus Hopk.
Pissodes rotundatus Lec.

Group IV.

Pytid beetles—Pythidae.
Pytho planus Hbst.

Group V.

Wood-boring beetles—Cerambycidae and Buprestidae.
Monochamus scutellatus Say.
Monochamus notatus Drury.
Monochamus titillator Fabr.
Tetropium cinnamopterum Kby.
Acmaeops proteus Kby.
Chrysobothris scabripennis Cast.

Group VI.

Sapwood borers—Melandryidae and Siricidae (Hym.).
Serropalpus barbatus Schall.
Sirex juvencus cyaneus Fabr.

The accompanying tables show the effect of time of cut on infestation of pine, spruce and balsam logs.

TABLE A.

THE EFFECT OF TIME OF CUT ON INFESTATION OF PINE LOGS.

Time of Cut	One season following attack (Examined Sept. 1937)	Two seasons following attack (Examined August, 1938)
Winter —1936-37	I. <i>Ips</i>) young adults present <i>Pityogenes</i> , and galleries scored sapwood surface.	No adults, galleries largely obliterated.
Spring (Late October 1936—middle May 1937)	III. <i>Pissodes</i> prepupae in "Chip cocoons".	Empty pupal cases.
	IV. <i>Pyro</i> larvae half grown.	Full grown <i>Pyro</i> larvae constructing circular pupal chambers between bark and wood.
	V. <i>Monochamus</i> larvae all in wood. <i>Acmocops</i> larvae on sapwood surface <i>Chrysobothris</i> larvae on sapwood surface.	Extensive tunneling, some emergence holes. Larvae on sapwood surface. Most in shallow pupal cells in sapwood
	VI. <i>Sirex</i>) larvae within sap- <i>Serropalpus</i>) wood on under- side of log.	Larvae full grown, still in sapwood.
June—1937	I. <i>Ips</i> , a few young adults present; galleries on sapwood surface. III. <i>Pissodes</i> prepupae in "Chip cocoons". V. <i>Monochamus</i> , a large percentage in the wood. <i>Tetropium</i> larvae, most in wood. <i>Acmocops</i> , on sapwood surface. <i>Chrysobothris</i> , on sapwood surface. VI. <i>Sirex</i>) larvae within sap- <i>Serropalpus</i>) wood on underside of log.	Galleries visible. Empty pupal cases. Most in wood, occasional emergence hole. Most have emerged, rest in wood. On sapwood surface. On sapwood surface. Larvae within sapwood on underside of log.
July—1937	As above but fewer <i>Monochamus</i> in the wood. <i>Ips</i> adults numerous. <i>Tetropium</i> between bark and wood.	Indistinguishable from June cut.
August—1937	I. <i>Ips</i> , larvae-pupae-young adults. II. IV. V. <i>Monochamus</i> , eggs; first and second stage larvae. <i>Tetropium</i>) Both small, <i>Chrysobothris</i>) early stages.	Galleries few. <i>Orthotomicus</i> , larvae-pupae-young adults. <i>Gnathotrichus</i>) tunnels, cradles and <i>Trypodendron</i>) exit holes. Small <i>Pyro</i> larvae. Up to 50% have entered wood. On sapwood surface or in process of cutting into wood to construct pupal chamber.
Sept.—1937	V. <i>Monochamus</i> eggs only.	Similar to August cut but only first and second stages. <i>Monochamus</i> larvae mainly of the 1938 infestation. No <i>Chrysobothris</i> or <i>Tetropium</i> larvae.

TABLE B.

THE EFFECT OF TIME OF CUT ON INFESTATION OF SPRUCE LOGS.

Time of Cut		
Winter —1936-37	One season following attack (Examined Sept. '37)	Two seasons following attack (Examined August '38)
Spring	I. <i>Polygraphus</i>) galleries of both on young adults) sapwood surface. <i>Dryocoetes</i>) larvae)	Engravings of both these species on sapwood.
(Late October 1936—middle May 1937)	III. <i>Pissodes</i> prepupae in "Chip cocoons".	Empty pupal cases.
	IV. <i>Pytho</i> larvae half grown. V. <i>Monochamus</i> larvae most in wood. <i>Acmaeops</i> larvae on sapwood surface. <i>Chrysobothris</i> larvae on sapwood surface.	A few full grown larvae. All in wood, most have tunneled to the centre of the log. Larvae on sapwood surface.
	VI. <i>Sirex</i>) larvae within sap- <i>Serropalpus</i>) wood on underside of log.	Larvae on sapwood surface. Larvae full grown, still in sapwood.
June—1937	I. <i>Polygraphus</i>) galleries of both young adults,) on sapwood <i>Dryocoetes</i>) surface. larvae)	Engravings of both these species on sapwood.
	III. <i>Pissodes</i> prepupae in "Chip cocoons".	Empty pupal cases.
	V. <i>Monochamus</i> larvae, most in wood. <i>Tetropium</i> larvae, most in wood. <i>Acmaeops</i>) both on sapwood <i>Chrysobothris</i>) surface.	<i>Monochamus</i> most in wood, to centre of log at least. Most have emerged; rest in wood. Both on sapwood surface.
	VI. <i>Sirex</i>) larvae within sap- <i>Serropalpus</i>) wood on under- side of log.	Larvae full grown, still in sapwood.
July—1937	As above but <i>Monochamus</i> only just entering wood. <i>Polygraphus</i> , larvae pupa-young adults. <i>Tetropium</i> be- tween bark and wood.	Indistinguishable from June cut.
August—1937	I. <i>Polygraphus</i> larvae and parent adults. <i>Dryocoetes</i> adults cutting galleries. II. IV. V. <i>Monochamus</i> eggs, first and second stage larvae. <i>Tetropium</i>) both small <i>Chrysobothris</i>) early stages.	Few galleries of these species evident; many <i>Orthotomicus</i> larvae, pupae and young adults. <i>Trypodendron</i>) tunnels, cradles and <i>Gnathotrichus</i>) exit holes. Small <i>Pytho</i> larvae. Up to 50% have entered the wood. Still on sapwood surface or cutting into wood to construct pupal chamber.
Sept.—1937	V. <i>Monochamus</i> eggs only.	Similar to August cut but <i>Monochamus</i> first and second stage larvae of 1938 infestation. No <i>Tetropium</i> or <i>Chryso- bothris</i> larvae.

TABLE C.

THE EFFECT OF TIME OF CUT ON INFESTATION OF BALSAM LOGS.

Time of Cut.	One season following attack (Examined Sept. 1937)	Two season following attack (Examined August 1938)
Winter 1936-37	I. <i>Pityokteines</i> , young adults and galleries.	Engravings on sapwood surface.
(Late October 1936—middle March 1937)	III. <i>Pissodes</i> prepupae in "Chip cocoons".	Empty pupal cases.
	V. <i>Monochamus</i> larvae, either under bark or in wood. <i>Acmaeops</i> on sapwood surface. <i>Chrysobothris</i> on sapwood surface.	Larvae all in wood, some exit holes. Both still on sapwood surface.
	VI. <i>Sirex</i>) larvae within sapwood on underside of logs. <i>Serropalpus</i>)	Numerous exit holes of both these species; few larvae still in sapwood.
Spring—1937 (April—May 1937)	As above but no <i>Pityokteines</i> adults or galleries.	As above but no <i>Pityokteines</i> engravings on sapwood surface.
June—1937.	III. <i>Pissodes</i> prepupae in "Chip cocoons". V. <i>Monochamus</i> , a small percentage in the wood. <i>Acmaeops</i> on sapwood surface. <i>Chrysobothris</i> on sapwood surface.	Empty pupal cases. Most in the wood, working towards the centre. Larvae on sapwood surface.
	VI. <i>Sirex</i>) larvae within sapwood on underside of logs. <i>Serropalpus</i>)	Larvae full grown within sapwood; some emergence holes.
July—1937.	As June cut but <i>Monochamus</i> almost all between bark and wood.	Indistinguishable from June cut.
August—1937.	II. V. <i>Monochamus</i> eggs, first and second stage larvae.	<i>Trypodendron</i> tunnels, cradles and exit holes. <i>Monochamus</i> , 50% have entered the wood.
September—1937	No infestation.	<i>Monochamus</i> , first and second stage larvae of 1938 infestation only. <i>Trypodendron</i> , as before.

With reference to the emergence and exit holes mentioned in the preceding tables, the following notes are given:

Species	Shape and average diameter of exit hole	Remarks
<i>Trypodendron</i>	Circular: 3/4"	"Pinholes", communicating with cylindrical branching tunnels running towards the centre of the wood, these usually blackened.
<i>Gnathothricus</i>	Circular; 2/4"	
<i>Sirex</i>	Circular; 7/4"	Communicating with oblique tunnels only on underside of log, all but the outlet tightly packed with very fine yellow frass.
<i>Serropalpus</i>	Circular; 5/4"	
<i>Tetropium</i>	Elliptical; 9-11/48" long axis.	Communicating with an L shaped pupal chamber ending blindly in the wood. Top and sides of log.
<i>Monochamus</i>	Circular; 12-16/48"	Communicating with a long U shaped tunnel running to the centre of the wood, and then out to another point from the sapwood surface.

Discussion. The present study shows that:

(i) There is a definite relation, as might be expected, between the infestation of logs and the time of cut. The flight period of each species differs

both as to time of occurrence and duration; furthermore, the food preference for logs at different stages in the seasoning process varies from species to species, hence it becomes possible to deduce from the nature of the insect attack the time of the year at which a log was cut.

(ii) Barkbeetles, as a rule, prefer the fresh cut logs. *Orthotomicus* appears to be an exception to this rule.

(iii) Ambrosia beetles, having an early spring period of flight, prefer the slightly seasoned logs cut in late summer and fail to those cut in winter. This is contrary to statements by Graham (1929) and others, who have called ambrosia beetles enemies of freshly cut and unseasoned wood. It is suggested that within limits of seasoning, the moisture content is probably the determining factor, the damp condition and heavy blue stain of the logs cut in August at both Laniel and on the Petawawa Forest Reserve being particularly noticeable the second season after cutting.

(iv) Wood borers of the genus *Monochamus*, which are considered as being the most destructive pest of unseasoned coniferous logs in Eastern Canada, are not affected by time of felling and will readily attack logs cut at all seasons.

(v) Logs cut in late summer and fall are not attacked by the sapwood borers, *Sirex* and *Serropalpus*.

(vi) Among the forms considered, the barkbeetles show a tendency to monophagy which is not so marked in other groups.

REFERENCES CITED

Graham, S. A.—Principles of Forest Entomology, p. 216-221, 1929. McGraw Hill Co., New York and London.

Martin, C. H.—Preliminary report of trap-log studies on elm bark-beetles. Jour. Econ. Ent. 29, p. 297-306, 1936.

BOOK NOTICE

Check List of the Lepidoptera of Canada and the United States of America. By J. McDunnough. Part 1, Macrolepidoptera; Part 2, Microlepidoptera. Memoirs of the Southern California Academy of Sciences, Los Angeles, volume 1 and volume 2, number 1, respectively. Price \$4.00 and \$2.50, respectively.

The plan for the publication of this work was announced on page 65 of the last volume of the "Canadian Entomologist". The first part was issued in June, 1938. It is a volume of 272 pages, and is based upon the author's own studies, as well as upon the literature concerning the various groups. Part 2 was published in July, 1939. It includes 171 pages and a list of corrections and additions to Part 1, and it follows recent revisions more closely than does Part 1 as regards the arrangement of genera and species. Each part includes its own index and considers all literature published before the end of 1938.

The Check List will, of course, replace the Barnes and McDunnough "List" of 1917. It is scarcely necessary to add that it will long remain indispensable to all those interested in North American Lepidoptera.

Mailed Thursday, November 30th, 1939

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